MODIFYING A GAME JOYSTICK TO BE USED WITH THE CELESTRON COMPUSTAR

INTRODUCTION

1. This page will go through the steps of modifying a game joystick so that it can be used with the Compustar computer. It is so much easier to use a joystick instead of the computer's motion control keys because a joystick has proportional control over the motion of the telescope. That means that the telescope will move faster the more you deflect the stick. You can count 30 or more different speeds as you advance the stick. This proportional control makes it particularly easy when performing finer movement. There will be no need to make multiple quick presses of the motion control keys to position the telescope where you want it.

2. I believe that the greatest use of the joystick is realized when you are looking through the eyepiece. Before I had a joystick I spent a great amount of time correcting the telescope movement because I pressed the wrong motion key to start with. The joystick can be held backwards and/or inverted so that your hand movement is intuitive as you move through the star fields.

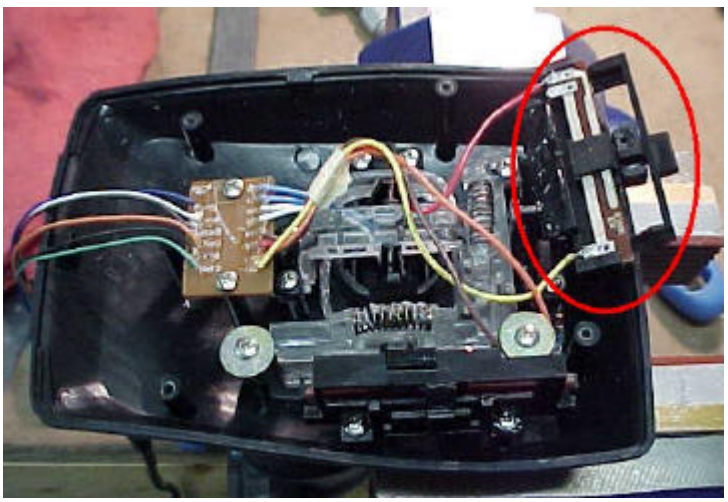
CHOOSING A JOYSTICK

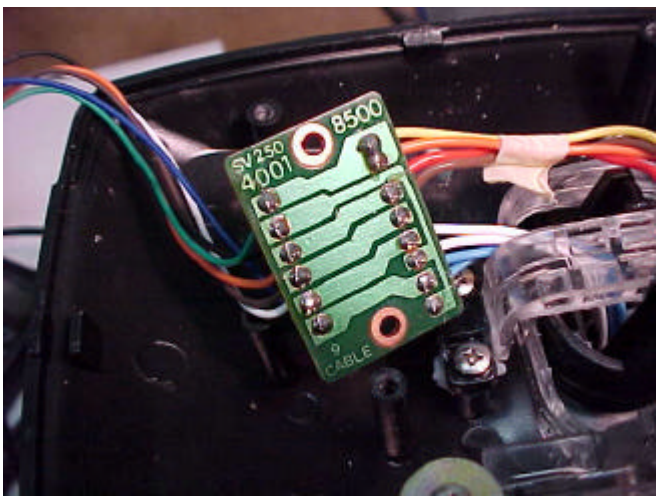
3. The original Celestron joystick was simply a joystick with two buttons. One button was to toggle between the "SET" and "SLEW" speed rates, and the other button was the same as pressing the "SYNC" command key. The joystick that you choose does not have to be any more elaborate than that. Today's game joysticks are much more sophisticated. You may in fact find it difficult to locate a new but simple joystick. I looked in six different stores before I found the one in the photo. I purchased it at a discount department store for nine dollars.

4. Another thing to look for are trim controls. These controls will make it easier to set up the joystick so that you can achieve maximum speed in all directions.

5. The inside of the joystick is also important. Most joysticks of this type are basically the same inside, however some are designed poorly. I located an old TANDY joystick at a computer surplus store that looked promising, but when I opened up the bottom, a couple of large springs snapped like a mouse trap and small parts were launched across the room. I still haven't found them all.

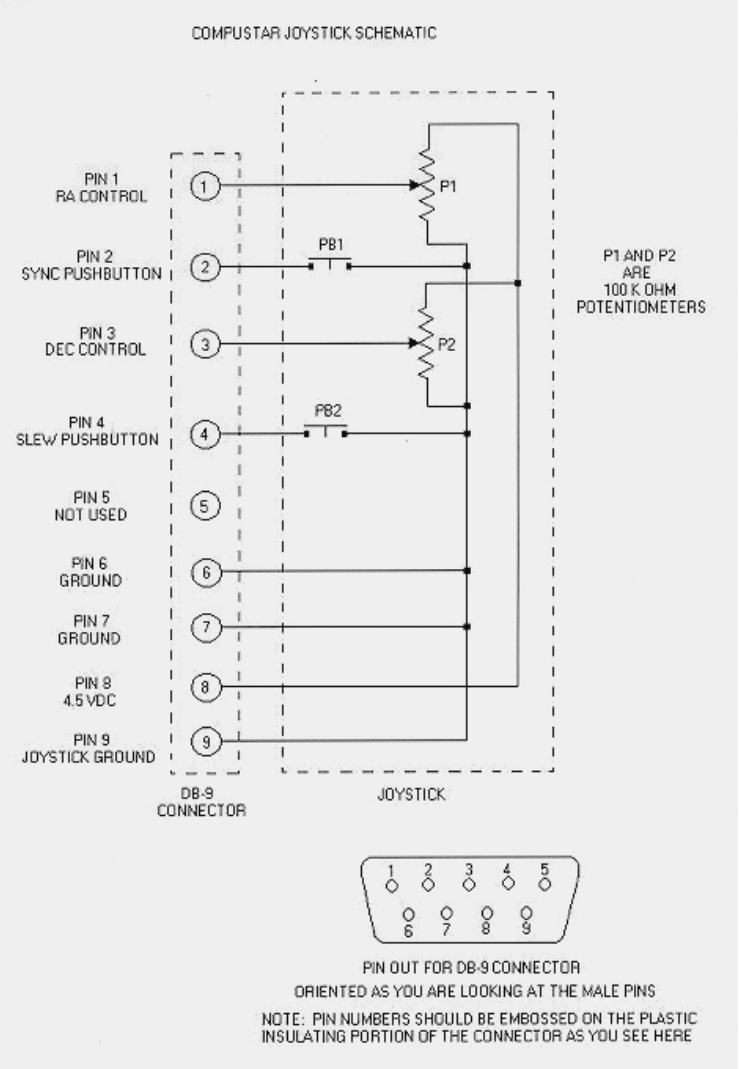
6. This particular joystick is very adaptable to modification. It has nice large linear potentiometers (Pots) with tabs that you can solder wires to. The red circle in the left photo shows the "X" axis Pot pulled out of its holder. It also has a Printed Circuit Card (PCC) that is used as an interface between the internal wiring of the joystick and the wiring of the cord. This PCC will be great for connecting a new cord for the Compustar.





MODIFYING THE JOYSTICK

7. The Compustar computer has three DB-9S connectors located on the front edge. The basic Compustar has nothing connected to any of these connectors. The connector on the right is for the joystick, the centre connector is for an Auto-Guider accessory and the left connector is an RS-232 computer interface.

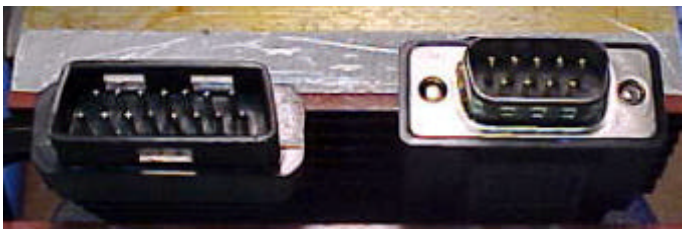


8. Unless the joystick you have has a male DB-9 connector already on the end of the cord it will have to be replaced with one so you can plug it in.

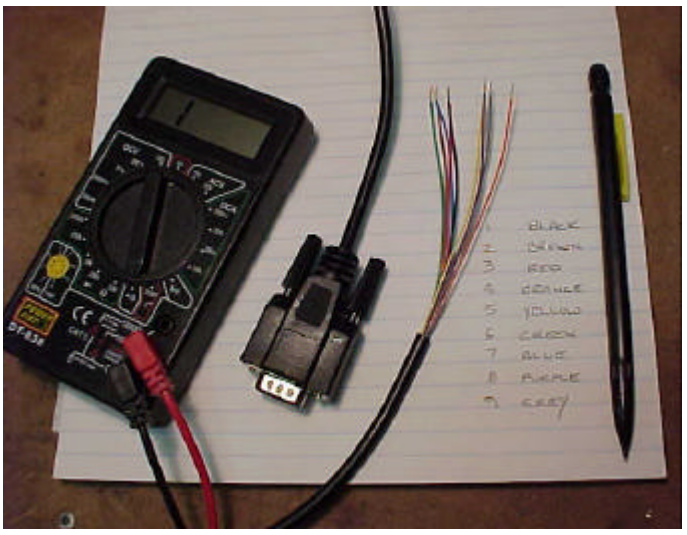
9. As you can see in the schematic, the DB-9 connector will use 8 wires coming from the joystick. Unless the cord on the joystick has at least 8 wires in it then the whole cord should be replaced.

10. It is possible to get away with as few as 6 wires in the cord going to the DB-9 connector. The schematic shows that Pin #6, #7 and #9 are actually connected together. These three pins can have jumpers installed at the connector and use a common wire through the cord to the joystick. It all depends on the manufacturer of the connector as to whether this is easy or not. I feel that it is easier to change the whole cord and make all the connections inside the joystick where there is much more room.

11. You can see that this joystick has a connector that is compatible with a gameport. It will have to be changed for the DB-9 connector on the right.

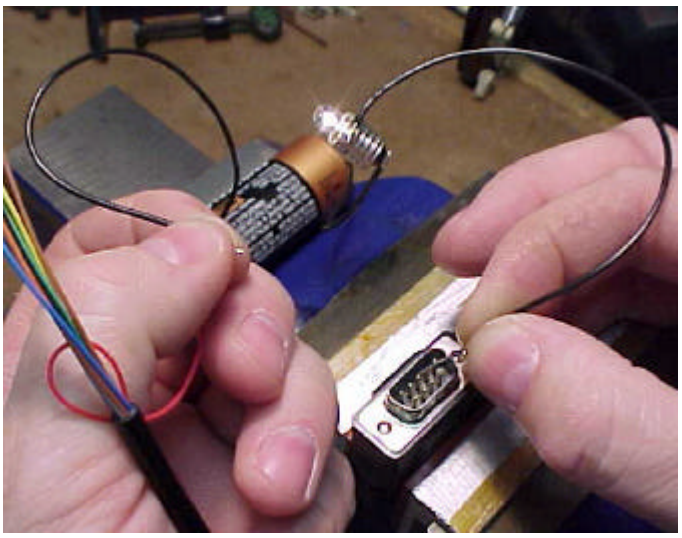


12. Even though the gameport connector has 15 pins, this joystick only has 6 wires in the cord. Due to this fact, I have decided to change the whole cord along with the connector. I was able to pick up a four foot 9 pin extension cord from a computer surplus store for $2.99. It will be just right to replace the cord on the joystick.



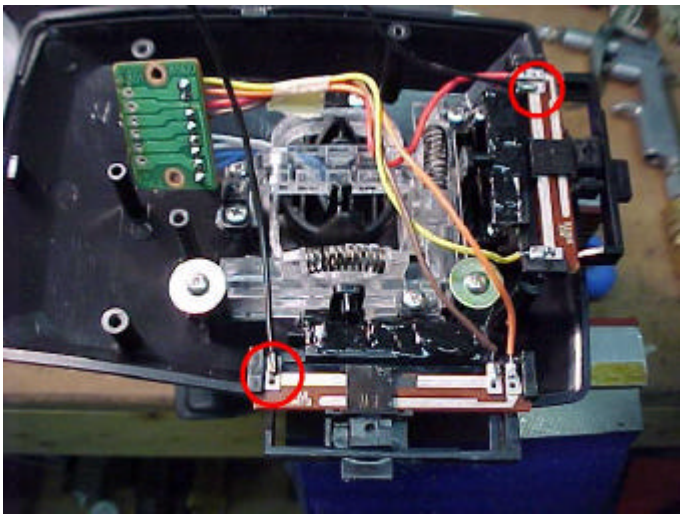
13. I cut off the female connector on the extension cord. Then I stripped back the insulation. In order not to have any problems with connecting the new cord, I performed a continuity check for each pin to determine the corresponding wire. You should write down which colour wire corresponds with the numbered pins on the connector. This will help when it comes time to connect the cord to the joystick.

14. If you do not have a multi-meter or cannot borrow one, you can still easily perform a continuity check by using a battery and light bulb. Select a wire and then check each pin until the circuit is complete. Using this method, the photo shows that it is the Red wire that corresponds with Pin #3 on the connector.



15. The next step is to cut off the old cord and clean up the holes in the PCC so you can solder on the new cord.

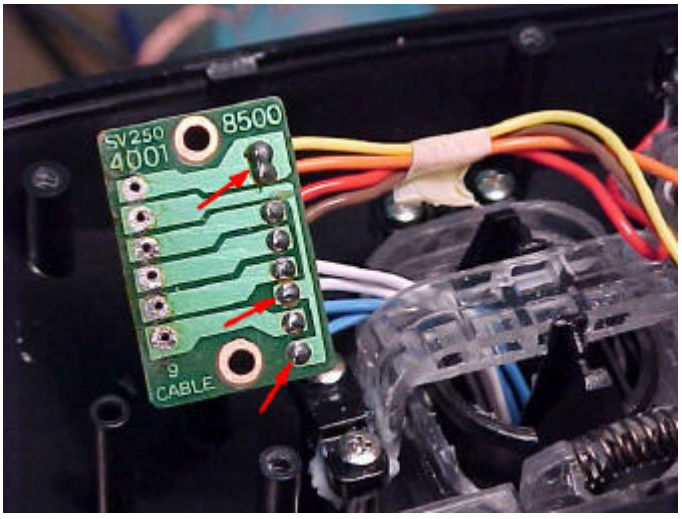
16. This joystick was originally wired using only a single side of each Pot. If you refer to the schematic you can see that the Compustar joystick needs to be wired on both sides of each Pot. In the photo you can see were I pulled out both Pots from their holders. The red circles indicate were I soldered new wires onto the tabs of the sides that were not used.



The Circuit

17. If you study the schematic you can see that it is actually fairly simple. There are two Pots, one for RA control and one for DEC control. Each Pot is connected to same ground on one side and voltage on the other side. On each Pot there is another wire connected to the part that slides across the resistor. This wire will also have a voltage reading, but the voltage will vary depending on where it is along the resistor. These wires that have variable voltage are connected to Pin #1 for RA control and Pin #3 for DEC control.

18. When you push the "ABORT" button on the Compustar computer it will carry out the abort command as normal. It will also look at Pin #1 and #3 to see if there is voltage present. If there is that means that a joystick is connected. As soon as those voltages start to change up or down that means that you are moving the joystick and the computer will tell the telescope to move depending on the voltage changes.



19. There are also two pushbuttons in the joystick circuit. Both pushbuttons are connected to ground on one side. PB1 is the pushbutton that acts like the "SYNC" command key on the computer and is also connected to Pin #2. PB2 is the slew pushbutton and is also connected to Pin #4. When PB1 is pressed it is basically touching Pin #2 to ground. This is the computers signal to carry out the "SYNC" command. Likewise when PB2 is pushed it touches Pin #4 to ground and this signals the computer to toggle between the "SET" and "SLEW" speed rates.

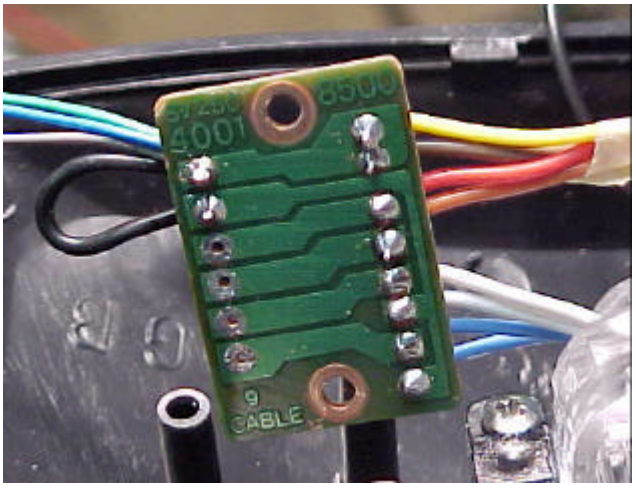
Re-wiring the Joystick

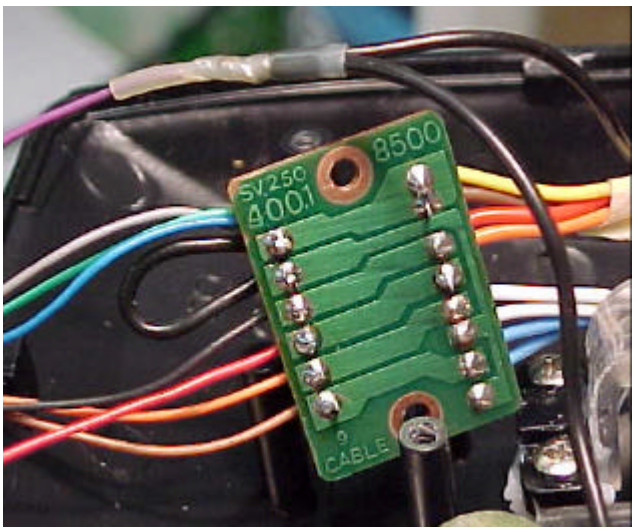
20. In the schematic, if you follow the conductor from Pin #9, you will see that it is connected to Pin #7 and #6, one side of PB2, one side of P2, one side of PB1 and one side of P1. In the photo above you can see the original joystick wiring to the PCC. The four wires at the top go to the Pots and the Blue and White sets of wires go to the fire buttons in the handle. The arrows indicate that the circuits on the PCC show one side of each button is

already connected together. Also there is a place at the top were two other wires can be connected together. These circuits on the PCC can be used to help connect all the ground connections together.

21. Inside the joystick, the Red and the Orange wire are connected to the variable tabs on each Pot. These have to be kept isolated so they can be connected to the wires in the cord that correspond to Pin #1 and #3. In order for the Red and Orange wire to be on independent circuits, I will switch the Orange and Brown wires on the PCC.

22. In the photo above you can see that all the ground connections are completed. The Green, Blue and Gray wires from the cord correspond to Pins #6, #7 and #9. The Brown and Yellow wire go to one side of each Pot, and you can see a jumper wire that connects to the PCC circuit that is connected to one side of each button.





23. The photo to the right shows the remainder of the cord connections completed. The table below outlines the connections that were made.

Pin Number	Colour of wire in cord	Colour of wire in joystick	Joystick Component
1	Black	Red	RA Pot
2	Brown	Blue	PB1
3	Red	Orange	DEC Pot
4	Orange	White	PB2
8	Purple	Black	Voltage to both Pots

24. The last wire in the cord is the Yellow wire that corresponds to Pin #5 and is not used. I just bent the end over and put on some shrink tubing to insulate the end.

SETTING UP THE JOYSTICK

25. Once your joystick is competed. You will likely have to make some adjustments to the trim controls. To set up the joystick, power up the Compustar, plug in the joystick and push the "ABORT" command key, this will activate the joystick. Push the button and select the "SLEW" speed rate. The "SLEW" speed rate is better to set up the joystick with because it is much easier to notice differences in speed rates as you deflect the stick. Next, fully deflect the stick in RA from left to right and notice if there is any difference in the speed rate between the two extremes. If there is, centre the stick and move the trim control for the RA Pot in the direction that was the faster of the two. The telescope will start moving in that direction as you adjust the trim control. Push the "ABORT" command key again and this will reset the joystick as if you had just plugged it in. Repeat the adjustments to the RA trim control until you can achieve full speed in both directions. Once the RA trim control is set, carry out the same procedure with the DEC control.

LESSONS LEARNED

26. The actual resistance value of the potentiometers in the joystick is not as important as being able to use the whole range of the variable resistor. The Compustar computer is supplying the voltage to the joystick and it uses the full range of voltage from "short to ground" to "full voltage" for its movement signals. I found this out when I used a joystick gimbals assembly from an old R/C transmitter for my first attempt at this project. These joysticks only use a small portion of the overall range of each potentiometer, so I was only able to achieve about 1/3 speed in any direction.

Good luck with the project and clear skies to all.
Cheers, Ken Whitnall from Ottawa, Canada.